

## 1 ADAPTER FOR USE WITH A TANDEM-FREE CONFERENCE BRIDGE

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3

4 **FIELD OF THE INVENTION**

5

6 The present invention relates in general to  
7 teleconferencing systems and, more particularly, to an  
8 adapter for use with a conference bridge that is capable of  
9 operating on compressed speech packets.

10

11 **BACKGROUND OF THE INVENTION**

12

13 In the interest of bandwidth economy, technologies have  
14 been developed to enable the transmission of compressed  
15 speech between media gateways in a network. Specifically,  
16 upon receipt of a speech signal from an end user, a media  
17 gateway encodes (or "compresses") the speech and sends the  
18 compressed speech to a remote media gateway in the network  
19 in the form of a compressed speech packet. At the remote  
20 gateway, the compressed speech is decoded (or  
21 "decompressed") into a speech signal and sent to an end  
22 user telephony device over a communication link, typically  
23 in a pulse coded modulation (PCM) format. The transmission  
24 of compressed speech between media gateways results in  
25 bandwidth economy.

26

27 In order to provide conferencing functionality, it is  
28 possible to introduce a device known as a "conference  
29 bridge" into the above scenario. However, a conventional  
30 conference bridge operates on decompressed speech signals,  
31 which leads to various disadvantages. Specifically, the  
32 introduction of a conventional conference bridge between  
33 media gateways requires an extra decompression stage at

1 each input to the conference bridge followed by an extra  
2 stage of compression at each output of the conferencing  
3 bridge. This is known as "tandem" operation of speech  
4 codecs caused by the use of a conventional conference  
5 bridge. The "tandem" operation of speech codecs described  
6 above induces a loss of perceived signal quality, as well  
7 as an increase in required processing power.

8  
9 Therefore, as an improvement, the concept of a "tandem-  
10 free" conference bridge has been introduced. As described  
11 in, for example, published United States Patent Application  
12 Serial No. 09/986,498 to Rabipour et al., filed on November  
13 9, 2001, published on August 8, 2002, hereby incorporated  
14 by reference herein, and the references cited therein, the  
15 tandem-free conference bridge makes forwarding decisions on  
16 the basis of "auxiliary information" received together with  
17 compressed speech for each media stream. Because of the  
18 presence of auxiliary information, the tandem-free bridge  
19 need not actually decode the compressed speech, hence  
20 resulting in an improvement in end-to-end speech quality.

21  
22 The reader may also find it useful to consult other  
23 references that describe tandem-free bridge capabilities,  
24 including U.S. Patent Application Serial No. 09/475,047  
25 entitled "Apparatus and Method for Packet-Based Media  
26 Communications" filed on December 30, 1999; U.S. Patent  
27 Application Serial No. 09/750,015 entitled "Apparatus and  
28 Method for Packet-Based Media Communications" filed on  
29 December 29, 2000, published on July 4, 2002; and U.S.  
30 Patent Application Serial No. 09/664,450 entitled  
31 "Apparatus and Method for Packet-Based Media  
32 Communications" filed on September 18, 2000. The contents

1 of each of these references is incorporated by reference  
2 herein.

3

4 However, conventional media gateways do not possess the  
5 additional ability to provide the auxiliary information  
6 expected by the tandem-free conference bridge, nor the  
7 additional ability to process the auxiliary information  
8 received from the tandem-free conference bridge.

9

10 One solution would be to provision all new media gateways  
11 with suitable hardware and/or software for tandem-free  
12 bridge compatibility in order to cover the eventuality of  
13 the media gateway participating in a conference call  
14 through a tandem-free bridge. However, this solution does  
15 not take into consideration the large number of media  
16 gateways that have already been deployed without the  
17 ability to generate or process auxiliary information. For  
18 these media gateways, an upgrade would now be required to  
19 render them compatible with a tandem-free conference  
20 bridge. This solution is both costly and inefficient.  
21 Moreover, some outdated equipment may not even be amenable  
22 to upgrades.

23

24 Against this background, it is clear that there is a need  
25 in the industry for an improved solution to allow media  
26 gateways to participate in a conference with a conference  
27 bridge that operates on compressed speech in a tandem-free  
28 mode, such that conferencing services can be introduced  
29 gradually and without a wholesale upgrade of deployed  
30 gateways.

31

32 **SUMMARY OF THE INVENTION**

33

1 A first broad aspect of the present invention seeks to  
2 provide a method of processing data carried on a media path  
3 between a first network element and a second network  
4 element. The method comprises receiving a stream of  
5 composite packets from the first network element, each  
6 composite packet carrying media information and auxiliary  
7 information pertaining to the composite packet. The method  
8 further comprises generating, on a basis of the media  
9 information and the auxiliary information carried in the  
10 composite packets, an output media stream free of the  
11 auxiliary information carried in the composite packets.  
12 The method also comprises releasing the output media stream  
13 towards the second network element.

14

15 A second broad aspect of the present invention seeks to  
16 provide an apparatus for processing data carried on a media  
17 path between a first network element and a second network  
18 element. The apparatus comprises means for receiving a  
19 stream of composite packets from the first network element,  
20 each composite packet carrying media information and  
21 auxiliary information pertaining to the composite packet.  
22 The apparatus also comprises means for generating, on a  
23 basis of the media information and the auxiliary  
24 information carried in the composite packets, an output  
25 media stream free of the auxiliary information carried in  
26 the composite packets. The apparatus further comprises  
27 means for releasing the output media stream towards the  
28 second network element.

29

30 A third broad aspect of the present invention seeks to  
31 provide an apparatus for processing data carried on a media  
32 path between a first network element and a second network  
33 element. The apparatus comprises a data interface

1 operative to receive a stream of composite packets from the  
2 first network element and to release an output media stream  
3 towards the second network element, each composite packet  
4 carrying media information and auxiliary information  
5 pertaining to the composite packet. The apparatus further  
6 comprises a processing entity operative to generate, on a  
7 basis of the media information and the auxiliary  
8 information carried in the composite packets, the output  
9 media stream free of the auxiliary information carried in  
10 the composite packets.

11

12 A fourth broad aspect of the present invention seeks to  
13 provide a computer program product for use with a  
14 conference bridge adapter located in a media path between a  
15 first data element and a second data element, the computer  
16 program product comprising a computer usable medium having  
17 computer readable program code thereon. The computer  
18 readable program code includes program code for receiving a  
19 stream of composite packets from the first network element,  
20 each composite packet carrying media information and  
21 auxiliary information pertaining to the composite packet.  
22 The computer readable program code also includes program  
23 code for generating, on a basis of the media information  
24 and the auxiliary information carried in the composite  
25 packets, an output media stream free of the auxiliary  
26 information carried in the composite packets. The computer  
27 readable program code further includes program code for  
28 releasing the output media stream towards the second  
29 network element.

30

31 A fifth broad aspect of the present invention seeks to  
32 provide a method of processing data carried on a media path  
33 between a first network element and a second network

1 element. The method comprises receiving a stream of  
2 packets from the first network element, each received  
3 packet carrying media information, deriving from the media  
4 information carried in each received packet auxiliary  
5 information pertaining to the received packet, generating a  
6 stream of composite packets, each said composite packet  
7 being produced from the media information carried in a  
8 respective received packet and the auxiliary information  
9 pertaining to the respective received packet and releasing  
10 the stream of composite packets towards the second network  
11 element.

12

13 A sixth broad aspect of the present invention seeks to  
14 provide an apparatus for processing data carried on a media  
15 path between a first network element and a second network  
16 element. The apparatus comprises means for receiving a  
17 stream of packets from the first network element, each  
18 received packet carrying media information, means for  
19 deriving from the media information carried in each  
20 received packet auxiliary information pertaining to the  
21 received packet, means for generating a stream of composite  
22 packets, each said composite packet being produced from the  
23 media information carried in a respective received packet  
24 and the auxiliary information pertaining to the respective  
25 received packet and means for releasing the stream of  
26 composite packets towards the second network element.

27

28 A seventh broad aspect of the present invention seeks to  
29 provide an apparatus for processing data carried on a media  
30 path between a first network element and a second network  
31 element. The apparatus comprises a data interface  
32 operative to receive a stream of packets from the first  
33 network element and to release a stream of composite

1 packets towards the second network element, each received  
2 packet carrying media information, a processing entity  
3 operative to derive from the media information carried in  
4 each received packet auxiliary information pertaining to  
5 the received packet, and a combiner operative to produce  
6 each composite packet by combining the media information  
7 carried in a respective received packet and the auxiliary  
8 information pertaining to the respective received packet.

9  
10 An eighth broad aspect of the present invention seeks to  
11 provide a computer program product for use with a  
12 conference bridge adapter located in a media path between a  
13 first data element and a second data element, the computer  
14 program product comprising a computer usable medium having  
15 computer readable program code thereon. The computer  
16 readable program code includes program code for receiving a  
17 stream of packets from the first network element, each  
18 received packet carrying media information, program code  
19 for deriving from the media information carried in each  
20 received packet auxiliary information pertaining to the  
21 received packet, program code for generating a stream of  
22 composite packets, each said composite packet being  
23 produced from the media information carried in a respective  
24 received packet and the auxiliary information pertaining to  
25 the respective received packet and program code for  
26 releasing the stream of composite packets towards the  
27 second network element.

28.

29 A ninth broad aspect of the present invention seeks to  
30 provide a method of establishing a media conference linking  
31 a plurality of endpoints via a conference bridge adapted to  
32 exchange composite packets carrying media information in  
33 conjunction with auxiliary information pertaining to the

1 media information. The method comprises (a) determining  
2 whether one or more of the endpoints is characterized by an  
3 inability to exchange composite packets with the conference  
4 bridge and (b) for at least one endpoint identified at a),  
5 routing the media path from said endpoint via an adapter  
6 that is capable of exchanging composite packets with the  
7 conference bridge.

8  
9 A tenth broad aspect of the present invention seeks to  
10 provide a teleconferencing network. The network comprises  
11 a conference bridge operative to communicate composite  
12 packets carrying media information in conjunction with  
13 auxiliary information pertaining to the media information,  
14 a plurality of conference endpoints, at least one of which  
15 is characterized by an inability to exchange the composite  
16 packets with the conference bridge and a bridge adapter  
17 located between the conference bridge and at least one  
18 endpoint characterized by an inability to exchange  
19 composite packets with the conference bridge, the adapter  
20 being operative to exchange composite packets with the  
21 conference bridge.

22  
23 The invention may be embodied in a processor readable  
24 medium containing a software program comprising  
25 instructions for a processor to implement any of the above  
26 described methods.

27  
28 It should be appreciated that the word "packet" as used  
29 herein should be construed broadly as encompassing any  
30 datagram format, including but not limited to Internet  
31 Protocol (IP), Asynchronous Transfer Mode (ATM), Ethernet,  
32 Frame Relay, etc.

33



1 These and other aspects and features of the present  
2 invention will now become apparent to those of ordinary  
3 skill in the art upon review of the following description  
4 of specific embodiments of the invention in conjunction  
5 with the accompanying drawings.

#### 6 7 **BRIEF DESCRIPTION OF THE DRAWINGS**

8  
9 In the accompanying drawings:

10  
11 Fig. 1 is a block diagram showing a tandem-free conference  
12 bridge and a bridge adapter involved in a three-way  
13 teleconference;

14  
15 Fig. 2 is a block diagram showing a plurality of IP phones  
16 involved in a teleconference;

17  
18 Figs. 3A to 3C are schematic block diagrams of the bridge  
19 adapter in accordance with embodiments of the present  
20 invention.

#### 21 22 **DETAILED DESCRIPTION OF THE EMBODIMENTS**

23  
24 Fig. 1 shows a communications architecture in which a  
25 plurality of end user devices 12, 14, 16 are desirous of  
26 participating in a teleconference across a network 10.  
27 Examples of end user devices 12, 14, 16 are telephony  
28 devices such as telephones. The end user devices 12, 14,  
29 16 communicate with respective media gateways 22, 24, 26  
30 via wireless or wireline links. The media gateways 22, 24,  
31 26 are connected to one another via links and nodes of the  
32 network 10.

33

1 The network 10 also includes a tandem-free conference  
2 bridge 30 that is capable of establishing an  $N$ -way  
3 conference (in the present non-limiting specific example,  $N$   
4 = 3) on the basis of  $N$  received data streams. In such an  
5 arrangement, each received data stream comprises packets  
6 that carry compressed speech for a given time interval.  
7 Each packet in the received data stream also comprises  
8 auxiliary information, which may include one or more of:  
9 signal level information for the corresponding time  
10 interval, speech segment classification information (e.g.,  
11 onset, sustained, offset, pause, and silence-  
12 identification), signal segment descriptors, signal power,  
13 a codec type, a speaker tag (identity of conference  
14 participant) or any other data element characterising the  
15 media information from which the compressed speech was  
16 derived.

17  
18 Generally speaking, one purpose of a tandem-free conference  
19 bridge, such as tandem-free bridge 30, is to perform  
20 speaker selection, i.e., to select  $M$  from amongst the the  $N$   
21 streams to deliver to each of the conference participants.  
22 The  $M$  selected streams are said to belong to "active"  
23 speakers. Typically,  $M$  is set to 2 or 3, depending on  
24 factors such as the desired level of transparency of the  
25 speaker selection, per link bandwidth, signal-to-noise  
26 considerations, endpoint processing power and so on.  
27 Speaker selection is performed on the basis of the  
28 auxiliary information. For example, since the bridge has  
29 knowledge of the signal power of each media stream, it can  
30 make a voice activity detector (VAD) decision and/or rank  
31 speakers based on how loudly they are talking. For more  
32 information regarding the manner in which speaker selection  
33 may be performed, the reader is referred to published

1 United States Patent Application Serial No. 09/986,498 to  
2 Rabipour et al., filed on November 9, 2001, and the  
3 references referred to therein, the contents of which are  
4 incorporated by reference herein.

5  
6 The compressed speech from the  $M$  selected streams is  
7 forwarded towards each participant's media gateway. In  
8 addition, some or all of the auxiliary information  
9 pertaining to the compressed speech is also forwarded  
10 towards each participant's media gateway. For instance,  
11 the auxiliary information forwarded to the media gateway  
12 may include the speaker tag and/or codec type. The speaker  
13 tag can be used by the media gateway to maintain a separate  
14 synthesis stream, while the codec type can be useful to  
15 select the most appropriate vocoder in cases where several  
16 codecs are used concurrently (e.g. wideband and  
17 narrowband).

18  
19 Thus, it will be appreciated that a full speech decoding  
20 process is not required at a tandem-free conference bridge  
21 since the information needed to carry out decisions is  
22 explicitly carried in each media stream by virtue of the  
23 auxiliary information. In this way, tandem speech decoding  
24 and re-encoding is avoided at the conference bridge, hence  
25 the term "tandem-free conference bridge". The avoidance of  
26 tandem encoding and decoding operations in the network  
27 tends to improve the perceived quality of the synthesized  
28 speech.

29  
30 Returning now to Fig. 1, media gateways 22, 24 are  
31 connected to the tandem-free conference bridge 30 by  
32 respective media paths 32, 34. For the purposes of the  
33 example being described here in relation to Fig. 1, media

1 gateways 22, 24 are assumed to be "compatible" with the  
2 tandem-free conference bridge 30. That is to say, in one  
3 direction of communication, each of the media gateways 22,  
4 24 is adapted to provide the tandem-free conference bridge  
5 30 with "composite" packets. Each of the composite packets  
6 carries compressed speech representative of speech  
7 originated by the respective end user device 12, 14 in a  
8 given time interval. Each of the composite packets also  
9 carries auxiliary information pertaining to the compressed  
10 speech carried in the composite packet.

11

12 In the opposite direction of communication, each of the  
13 media gateways 22, 24 is adapted to synthesize a speech  
14 signal for the respective end user device 12, 14, based on  
15  $M$  streams of composite packets received from the tandem-  
16 free conference bridge 30. Each such composite packet  
17 carries compressed speech for a given time interval and  
18 auxiliary information pertaining to the compressed speech  
19 carried in the packet. Since  $M$  selected streams are  
20 received from the tandem-free conference bridge 30, there  
21 will be up to  $M$  compressed speech packets received by each  
22 of the media gateways 22, 24 for each time interval,  
23 corresponding to the  $M$  active speakers.

24

25 For its part, media gateway 26 is connected to the tandem-  
26 free conference bridge 30 by a media path 36. For the  
27 purposes of the example being described here in relation to  
28 Fig. 1, media gateway 26 is assumed to be incompatible with  
29 the tandem-free conference bridge 30. That is to say, in  
30 one direction of communication, media gateway 26 produces  
31 packets containing compressed speech or uncompressed speech  
32 (i.e., waveform data) representative of speech originated  
33 by the end user device 16, without any auxiliary

1 information, for transmission into the network 10. In the  
2 opposite direction of communication, media gateway 26  
3 expects to receive packets containing compressed speech or  
4 uncompressed speech (i.e., waveform data) from at most one  
5 speaker at a time, for synthesis and transmission to the  
6 end user device 16. The media gateway 26 is characterized  
7 by an inability to process auxiliary information that forms  
8 part of the composite packets sent by the tandem-free  
9 conference bridge 30.

10

11 In order to allow the tandem-free conference bridge 30 to  
12 nevertheless serve as a bridge for a teleconference  
13 involving media gateways 22, 24 and 26 (i.e., including  
14 both compatible and incompatible media gateways), the  
15 network 10 comprises a bridge adapter 32 (hereinafter  
16 simply referred to as "adapter" 32) through which the media  
17 path 36 between the media gateway 26 and the tandem-free  
18 conference bridge 30 is routed. The routing of the media  
19 path 36 through the adapter 32 can be achieved during call  
20 setup, for example.

21

22 A first embodiment of the adapter 32 is shown in Fig. 3A,  
23 wherein there is only a single active speaker (i.e.,  $M =$   
24 1). The adapter 32 is seen to comprise a data interface  
25 42A for exchanging data with the tandem-free conference  
26 bridge 30 and a data interface 42B for exchanging data with  
27 the media gateway 26. Specifically, the data received from  
28 the tandem-free conference bridge 30 comprises composite  
29 packets 402 containing compressed speech and auxiliary  
30 information pertaining to the compressed speech in each of  
31 the composite packets 402. In the present example, the  
32 auxiliary information includes a speaker tag indicative of  
33 a selected speaker, in this case "12" being indicative of

1 end user device 12. As mentioned before, the auxiliary  
2 information may include different information instead of,  
3 or in addition to, the speaker tag. The data interface 42A  
4 forwards the composite packets 402 to a processing entity  
5 74. The processing entity 74 is adapted to remove the  
6 auxiliary information from the composite packets 402 and  
7 process it if necessary. In the present example, there is  
8 only one active speaker, and therefore the function of the  
9 processing entity 74 may be as simple as the mere removal  
10 of the auxiliary information, resulting in compressed  
11 speech packets 404 being fed to the data interface 42B.  
12 The data interface 42B accordingly provides the compressed  
13 speech packets 404 to the media gateway 26.

14  
15 In the reverse direction of communication, the data  
16 received from the media gateway 26 at the data interface  
17 42B comprises compressed speech packets 452. The data  
18 interface 42B forwards the compressed speech packets 452 to  
19 a decoder 82, which converts the compressed speech packets  
20 into uncompressed speech packets 454 (i.e., waveform data  
21 such as PCM samples). The uncompressed speech packets 454  
22 are fed to an auxiliary information extractor 84  
23 (hereinafter referred to simply as "extractor 84"), which  
24 processes the uncompressed speech packets 454 to extract  
25 auxiliary information 456 therefrom. The extracted  
26 auxiliary information can be referred to as auxiliary  
27 information. In the present example, the auxiliary  
28 information 456 includes a signal power, which can be  
29 measured from the uncompressed speech packets 454 by a  
30 signal power measurement unit forming part of the extractor  
31 84. The auxiliary information 456 may also include a  
32 speaker tag, which identifies the end user device 16 from  
33 which the speech in the uncompressed speech packets 454

1 originated. This may be obtained on the basis of a source  
2 address of the compressed speech packets 452. The  
3 extractor 84 provides the auxiliary information 456 to a  
4 combiner 86, which also receives the compressed speech  
5 packets 452 from the data interface 42B. The combiner 82  
6 associates (e.g., appends, concatenates, etc.) the  
7 auxiliary information 456 to the compressed speech packets  
8 452 to create composite packets 458 that are fed to the  
9 data interface 42A. The data interface 42A accordingly  
10 forwards the composite speech packets 458 to the tandem-  
11 free conference bridge 30.

12  
13 A second embodiment of the adapter 32 is shown in Fig. 3B,  
14 wherein there are two active speakers (i.e.,  $M = 2$ ). The  
15 adapter 32 is seen to comprise a data interface 42A for  
16 exchanging data with the tandem-free conference bridge 30  
17 and a data interface 42B for exchanging data with the media  
18 gateway 26. Specifically, the data received from the  
19 tandem-free conference bridge 30 comprises composite  
20 packets 402 containing compressed speech and auxiliary  
21 information pertaining to the compressed speech in each of  
22 the composite packets 402. In the present example, the  
23 auxiliary information includes a speaker tag indicative of  
24 a selected speaker, either "12" being indicative of end  
25 user device 12 or "14" being indicative of end user device  
26 14. As mentioned before, the auxiliary information may  
27 include different information instead of, or in addition  
28 to, the speaker tag. The data interface 42A forwards the  
29 composite packets 402 to a processing entity 74.

30  
31 The processing entity 74 is adapted to remove the auxiliary  
32 information from the composite packets 402 and process it  
33 if necessary. In the present example, there are two active

1 speakers, and therefore the function of the processing  
2 entity 74 may be as simple as the sorting of the composite  
3 packets 402 into one of two streams of compressed speech  
4 packets 404A, 404B, based on the speaker identified in the  
5 auxiliary information. In another embodiment, the  
6 processing entity 74 may determine a vocoder type from the  
7 auxiliary information, which may indicate that the two  
8 streams of compressed speech packets 404A, 404B have been  
9 compressed using different vocoder rates or algorithms, for  
10 example.

11  
12 The two streams of compressed speech packets 404A, 404B are  
13 fed to respective decoders 76A, 76B. Decoder 76A converts  
14 the speech in the respective stream of compressed speech  
15 packets 404A into a stream of uncompressed speech packets  
16 408A (e.g., waveform data such as PCM samples). Similarly,  
17 decoder 76B converts the speech in the respective stream of  
18 compressed speech packets 404B into a stream of  
19 uncompressed speech packets 408B (e.g., waveform data such  
20 as PCM samples). It is recalled that the processing entity  
21 74 may indicate to each of the decoders 76A, 76B that it is  
22 to use a different rate or algorithm, for example. The  
23 uncompressed speech packets 408A, 408B are fed to a  
24 combiner 78, which mixes together individual packets from  
25 each stream, thereby creating a stream of resultant  
26 uncompressed speech packets 410. The resultant  
27 uncompressed speech packets 410 are fed to an encoder 80,  
28 which re-encodes the speech, resulting in compressed speech  
29 packets 406. The compressed speech packets 406 are fed to  
30 the data interface 42B, which accordingly forwards the  
31 speech packets 406 to the media gateway 26. In an  
32 alternative embodiment, the encoder 80 produces compressed  
33 speech which is packetized by the data interface 42B.



1  
2 In the reverse direction of communication, essentially the  
3 same operations are performed as before. Specifically, the  
4 data received from the media gateway 26 at the data  
5 interface 42B comprises compressed speech packets 452. The  
6 data interface 42B forwards the compressed speech packets  
7 452 to a decoder 82, which is adapted to produce  
8 uncompressed speech packets 454 (i.e., waveform data such  
9 as PCM samples). The uncompressed speech packets 454 are  
10 fed to an extractor 84, which processes the uncompressed  
11 speech packets 454 to extract auxiliary information 456  
12 therefrom. The extracted auxiliary information can be  
13 referred to as auxiliary information. In the present  
14 example, the auxiliary information 456 includes a signal  
15 power, which can be measured from the uncompressed speech  
16 packets 454 by a signal power measurement unit forming part  
17 of the extractor 84. The auxiliary information 456 may  
18 also include a speaker tag, which identifies the end user  
19 device 16 from which the speech in the uncompressed speech  
20 packets 454 originated. This may be obtained on the basis  
21 of a source address of the compressed speech packets 452.  
22 The extractor 84 provides the auxiliary information 456 to  
23 a combiner 86, which also receives the compressed speech  
24 packets 452 from the data interface 42B. The combiner 82  
25 combines (e.g., appends, concatenates, etc.) the auxiliary  
26 information 456 to the compressed speech packets 452 to  
27 create composite packets 458 that are fed to the data  
28 interface 42A. The data interface 42A accordingly forwards  
29 the composite speech packets 458 to the tandem-free  
30 conference bridge 30.

31  
32 Those skilled in the art will of course appreciate that the  
33 concepts described herein above can be extended to

1 situations when there are more than two active speakers.  
2 Also, the above description has assumed that each of the  
3 gateways 22, 24, 26 is adapted to receive speech from an  
4 end user device in PCM format and encode the speech into  
5 vocoder-compressed speech parameters. The typical reason  
6 for such encoding is to drastically reduce the bandwidth  
7 required to transmit human speech by representing the  
8 speech in terms of parametric data rather than waveform  
9 data. However, this need not be the case. In fact,  
10 embodiments of the invention are contemplated in which the  
11 gateways 22, 24, 26 are accustomed to sending and receiving  
12 uncompressed speech (i.e., waveform data such as PCM  
13 samples).

14  
15 Accordingly, a third embodiment of the adapter 32 is shown  
16 in Fig. 3C, wherein there are again two active speakers  
17 (i.e.,  $M = 2$ ). However, in this case, the media gateway  
18 exchanges speech in uncompressed form (e.g., PCM samples).  
19 The adapter 32 is seen to comprise a data interface 42A for  
20 exchanging data with the tandem-free conference bridge 30  
21 and a data interface 42B for exchanging data with the media  
22 gateway 26. Specifically, the data received from the  
23 tandem-free conference bridge 30 comprises composite  
24 packets 402 containing compressed speech and auxiliary  
25 information pertaining to the compressed speech in each of  
26 the composite packets 402. In the present example, the  
27 auxiliary information includes a speaker tag indicative of  
28 a selected speaker, either "12" being indicative of end  
29 user device 12 or "14" being indicative of end user device  
30 14. As mentioned before, the auxiliary information may  
31 include different information instead of, or in addition  
32 to, the speaker tag. The data interface 42A forwards the  
33 composite packets 402 to a processing entity 74.

1

2 The processing entity 74 is adapted to remove the auxiliary  
3 information from the composite packets 402 and process it  
4 if necessary. In the present example, there are two active  
5 speakers, and therefore the function of the processing  
6 entity 74 may be as simple as the sorting of the composite  
7 packets 402 into one of two streams of compressed speech  
8 packets 404A, 404B, based on the speaker identified in the  
9 auxiliary information. In another embodiment, the  
10 processing entity 74 may determine a vocoder type from the  
11 auxiliary information, which may indicate that the two  
12 streams of compressed speech packets 404A, 404B have been  
13 compressed using different vocoder rates or algorithms, for  
14 example.

15

16 The two streams of compressed speech packets 404A, 404B are  
17 fed to respective decoders 76A, 76B. Decoder 76A converts  
18 the speech in the respective stream of compressed speech  
19 packets 404A into a stream of uncompressed speech packets  
20 408A (e.g., waveform data such as PCM samples). Similarly,  
21 decoder 76B converts the speech in the respective stream of  
22 compressed speech packets 404B into a stream of  
23 uncompressed speech packets 408B (e.g., waveform data such  
24 as PCM samples). It is recalled that the processing entity  
25 74 may indicate to each of the decoders 76A, 76B that it is  
26 to use a different rate or algorithm, for example. The  
27 uncompressed speech packets 408A, 408B are fed to a  
28 combiner 78, which mixes together individual packets from  
29 each stream, thereby creating a stream of resultant  
30 uncompressed speech packets 410. The resultant  
31 uncompressed speech packets 410 are fed to the data  
32 interface 42B, which accordingly forwards the speech  
33 packets 406 to the media gateway 26.

1  
2 In the reverse direction of communication, the data  
3 received from the media gateway 26 at the data interface  
4 42B comprises uncompressed speech packets 454. The data  
5 interface 42B forwards the uncompressed speech packets 454  
6 to both an encoder 88 and an extractor 84. The encoder  
7 encodes the uncompressed speech packets, resulting in  
8 compressed speech packets 452, which is fed to a combiner  
9 86. The extractor processes the uncompressed speech  
10 packets 454 to extract auxiliary information 456 therefrom.  
11 The extracted auxiliary information can be referred to as  
12 auxiliary information. In the present example, the  
13 auxiliary information 456 includes a signal power, which  
14 can be measured from the uncompressed speech packets 454 by  
15 a signal power measurement unit forming part of the  
16 extractor 84. The auxiliary information 456 may also  
17 include a speaker tag, which identifies the end user device  
18 16 from which the speech in the uncompressed speech packets  
19 454 originated. This may be obtained on the basis of a  
20 source address of the uncompressed speech packets 454. The  
21 extractor 84 provides the auxiliary information 456 to the  
22 combiner 86. The combiner 82 associates (e.g., appends,  
23 concatenates, etc.) the auxiliary information 456 to the  
24 compressed speech packets 452 to create composite packets  
25 458 that are fed to the data interface 42A. The data  
26 interface 42A accordingly forwards the composite speech  
27 packets 458 to the tandem-free conference bridge 30.

28

29 One way of setting up a teleconference using the tandem-  
30 free conference bridge 30 and the adapter 32 is now  
31 described with reference again to Fig. 1. From a control  
32 plane perspective, the media gateways 22, 24, 26, the  
33 tandem-free conference bridge 30 and the adapter 32 are

1 controlled by network elements 52, 54, 56 that act as media  
2 gateway controllers. In this specific example, media  
3 gateway controller 52 has control over media gateway 22,  
4 media gateway controller 54 has control over media gateway  
5 54 and the tandem-free conference bridge 30, and media  
6 gateway controller 56 has control over media gateway 26 and  
7 the adapter 32.

8  
9 To establish the conference, the media gateway controllers  
10 52, 54, 56 communicate with each other using a signalling  
11 protocol. Signalling between media gateway controllers 52  
12 and 54 will reveal that these media gateways are both  
13 compatible with the tandem-free conference bridge 30.  
14 Thus, media gateway controller 52 establishes media path 32  
15 between media gateway 22 and the tandem-free conference  
16 bridge 30, while media gateway controller 54 establishes  
17 media path 34 between media gateway 24 and the tandem-free  
18 conference bridge 30.

19  
20 However, signalling between media gateway controller 56 and  
21 either media gateway controller 52 or media gateway  
22 controller 54 will reveal that media gateway 26 is not  
23 compatible with the tandem-free conference bridge 30.  
24 Thus, media gateway controller 56 causes media path 36 to  
25 pass through adapter 32 between media gateway 26 and the  
26 tandem-free conference bridge 30. In addition, the media  
27 gateway controller 56 activates the appropriate  
28 functionality / configuration of the adapter 32, e.g., the  
29 functionality of the processing entity 74, the number of  
30 decoders 76A, 76B, the presence / absence of the decoder  
31 82, encoder 88 and encoder 80, the presence / absence of  
32 the combiner 80, etc.

33

1 It will be apparent that the routing of media path 36  
2 through the adapter 32 allows end user device 16 to  
3 participate in a conference with end user devices 12, 14  
4 via the tandem-free conference bridge 30. Hence, the  
5 provision of the adapter 32 eliminates the need to retrofit  
6 existing media gateways with the ability to interface with  
7 newly available tandem-free conference bridges. Advantages  
8 also arise in those instances where it may not be possible  
9 to implement tandem-free conferencing until standards have  
10 been defined; in absence of such standards, the adapter 32  
11 would allow the implementation of tandem-free conferencing  
12 to work with standard existing devices.

13

14 It should also be understood that the present invention  
15 imposes no limitation on the number of participants in the  
16 conference of interest, nor on the number of active  
17 speakers, nor on whether a particular media gateway that  
18 participates in the conference is compatible or  
19 incompatible with the tandem-free conference bridge 30. In  
20 the present case, the selection of media gateway 26 as  
21 being incompatible with the tandem-free conference bridge  
22 30 has been made completely arbitrarily and by way of  
23 illustration only.

24

25 It is envisaged that in the scenario where the majority of  
26 the media gateways in the network 10 would be incompatible  
27 with the tandem-free conference bridge 30, a bank of  
28 adapters 32 may be made available in the network 10 so as  
29 to be used by conferees when required. For example,  
30 consider the scenario depicted in Fig. 2, where four "IP  
31 phones" 202, 204, 206, 208 are desirous of participating in  
32 a telephone conference. Each of the IP phones 202, 204,  
33 206, 208 comprises the functionality of a telephone as well

1 as a vocoder to exchange compressed speech with the network  
2 10. In this sense, packet-based speech and possibly video  
3 is transmitted towards the conference bridge 30. However,  
4 the IP phones are not aware that the conference bridge 30  
5 is a tandem-free conference bridge that exchanges composite  
6 packets, each composite packet carrying media information  
7 in conjunction with auxiliary information pertaining to the  
8 media information. It is therefore envisaged that a  
9 plurality of adapters 232, 234, 236, 238 would be located  
10 in the media paths between the respective IP phones 202,  
11 204, 206, 208 and the tandem-free bridge 30, until such  
12 time as IP phones are upgraded to support interaction with  
13 tandem-free conference bridges.

14

15 Those skilled in the art will also appreciate that the  
16 present invention can also be applied to videoconferencing  
17 where there is provided a bridge that performs video stream  
18 selection on the basis of auxiliary information pertaining  
19 to packets in each of a plurality of compressed video  
20 streams. Therefore, the present invention is not limited  
21 to packets of compressed and uncompressed speech, but  
22 rather is applicable additionally to packets of compressed  
23 and uncompressed video and, more generally, to packets of  
24 compressed and uncompressed "media", where media includes  
25 but is not limited to one or more of speech, audio, still  
26 imagery and video.

27

28 It should also be understood that the word "packet" as used  
29 herein should be construed broadly as encompassing any  
30 datagram format, including but not limited to Internet  
31 Protocol (IP), Asynchronous Transfer Mode (ATM), Ethernet,  
32 Frame Relay, etc.

33

1 Those skilled in the art will appreciate that in some  
2 embodiments, the functionality of the adapter 32 (e.g.,  
3 processing entity 74, decoders 76A, 76B, combiner 78,  
4 encoder 80, decoder 82, extractor 84, combiner 86, encoder  
5 88) may be implemented as pre-programmed hardware or  
6 firmware elements (e.g., application specific integrated  
7 circuits (ASICs), electrically erasable programmable read-  
8 only memories (EEPROMs), etc.), or other related  
9 components. In other embodiments, the adapter 32 may be  
10 implemented as an arithmetic and logic unit (ALU) having  
11 access to a code memory (not shown) which stores program  
12 instructions for the operation of the ALU. The program  
13 instructions could be stored on a medium which is fixed,  
14 tangible and readable directly by the adapter 32, (e.g.,  
15 removable diskette, CD-ROM, ROM, or fixed disk), or the  
16 program instructions could be stored remotely but  
17 transmittable to the adapter 32 via a modem or other  
18 interface device (e.g., a communications adapter) connected  
19 to a network over a transmission medium. The transmission  
20 medium may be either a tangible medium (e.g., optical or  
21 analog communications lines) or a medium implemented using  
22 wireless techniques (e.g., microwave, infrared or other  
23 transmission schemes).

24

25 While specific embodiments of the present invention have  
26 been described and illustrated, it will be apparent to  
27 those skilled in the art that numerous modifications and  
28 variations can be made without departing from the scope of  
29 the invention as defined in the appended claims.

30